Test Platform for Advanced Digital Control of Brushless DC Motors

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Objective

To develop a test platform for the development, implementation and evaluation of optimal, adaptive and other advanced control approaches for the control of brushless DC motors (BLDC) in translation and positioning systems.   The selected control approach will be implemented as a digital control algorithm on an embedded processor. Common applications for BLDC motor-driven systems include translation of specimens in microgravity experiments and electromechanical actuation of nozzle and fuel valves in propulsion systems. The performance of the advanced control approaches will be compared with the performance of the common linear proportional-integral-derivative (PID) controller approach to control of such systems. Secondly to design and fabricate a controller board using a DSP chip suitable for the implementation of the advanced control approaches. This board will have a small form factor and will serve as the main processing unit for the digital control algorithm. This effort will provide experience and reusable algorithms for application to future microgravity and space transportation projects. The effort is based on existing control hardware and software developed for microgravity experiments. This existing control system design is used to implement a general test platform consisting of a computer to compile and download the control algorithm code to the DSP on the controller card. The computer is used to debug the code and to provide performance data storage and analysis. The controller card acquires feedback signals from position and velocity sensors, through appropriate signal conditioning circuitry, and provides command signals to the motor driver for a BLDC motor-driven system.

Why Needed

The advanced control approaches will improve the performance of the control system, when compared with the performance of the linear PID approach. The improvements are expected to include reduced control effort (power consumption) and reduced tracking error, with respect to position or velocity control. It is expected that the use of these approaches of this effort in future designs will provide improvements in system performance with respect to system error and control effort exerted (power consumed). The skills, hardware and control code developed during this investigation can be applied to BLDC motor-driven systems in microgravity experiments and space transportation systems. The electromechanical actuators (EMA) developed for use in nozzle and fuel valve positioning are BLDC motor-based designs.   This effort will provide control designs that can be directly applied to EMA driven systems. These funds and manpower are not available on a current project.

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Sponsor

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